

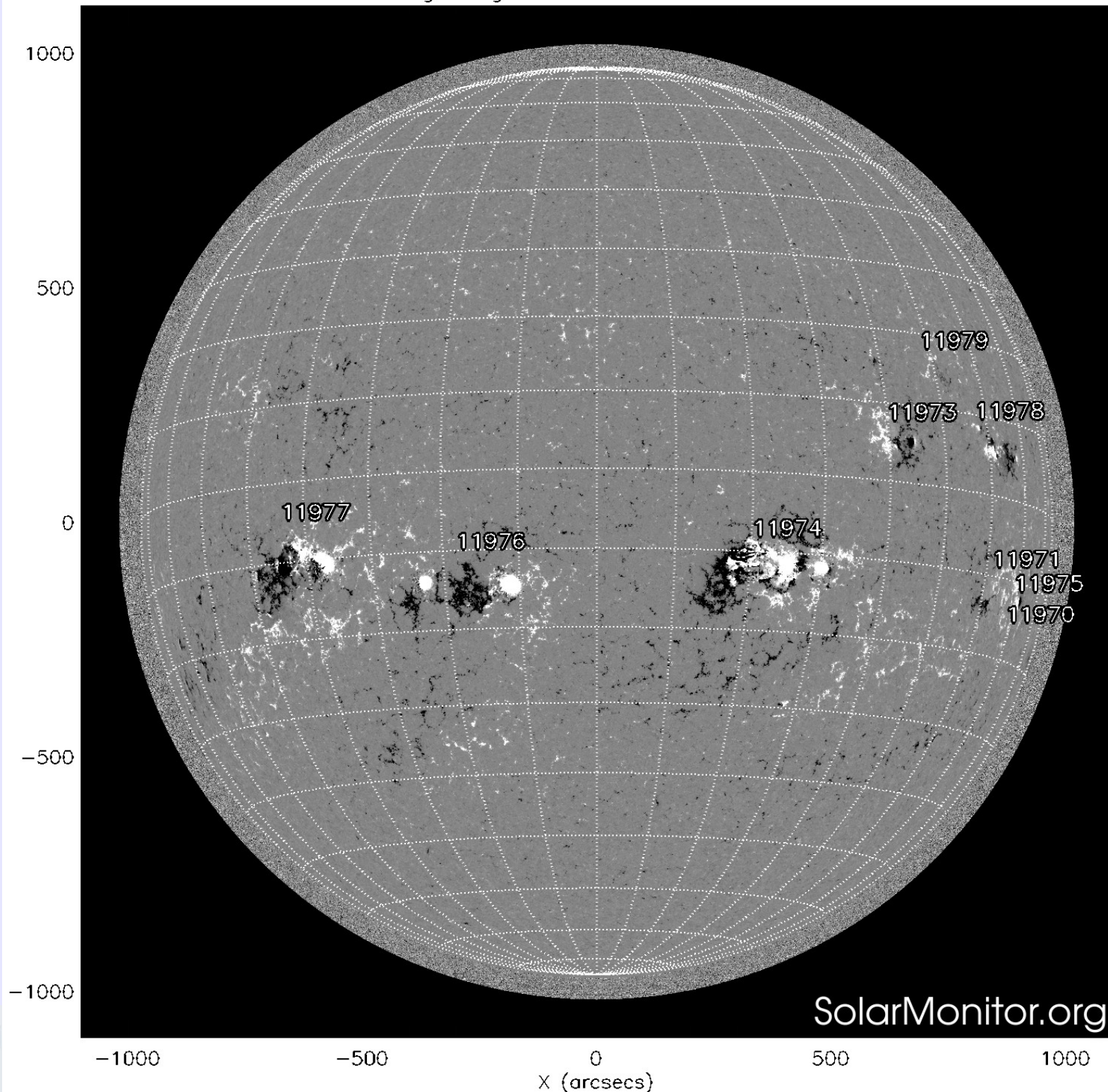
Present Status and Utility of Operational Solar Magnetic Field Observations in the context of NOAA/GOES-NEXT

**Dr. KD Leka
NWRA**

- Why useful?
- What's available now?
- What would be viable/useful operationally?

Why useful?

SDO HMI Magnetogram 13-Feb-2014 19:46:11.100



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Presently:

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- The *only* way to identify magnetic polarities.

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 - WSA/ENLIL, PFSS, *etc.*

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 - Corollary: Coronal Mass Ejections & Solar Energetic Particle Events are generally related to solar flare events.
 - All research & development-phase flare prediction schemes presently use magnetic field data.
 - Vetted proxies for magnetic free energy.

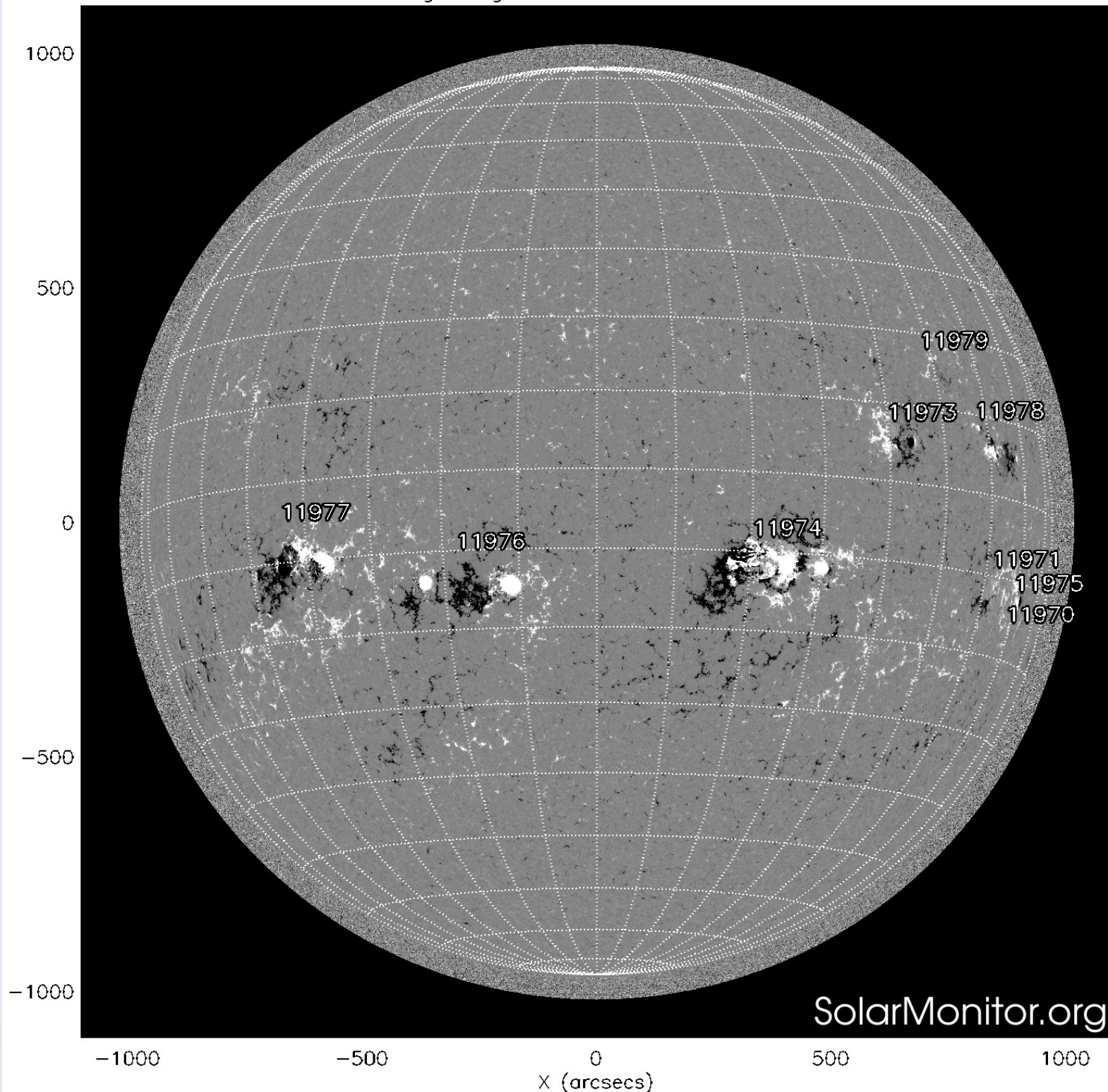
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 - Vetted proxies for magnetic free energy.
- **A *good* way to characterize the start/progress/end of a solar activity cycle.**

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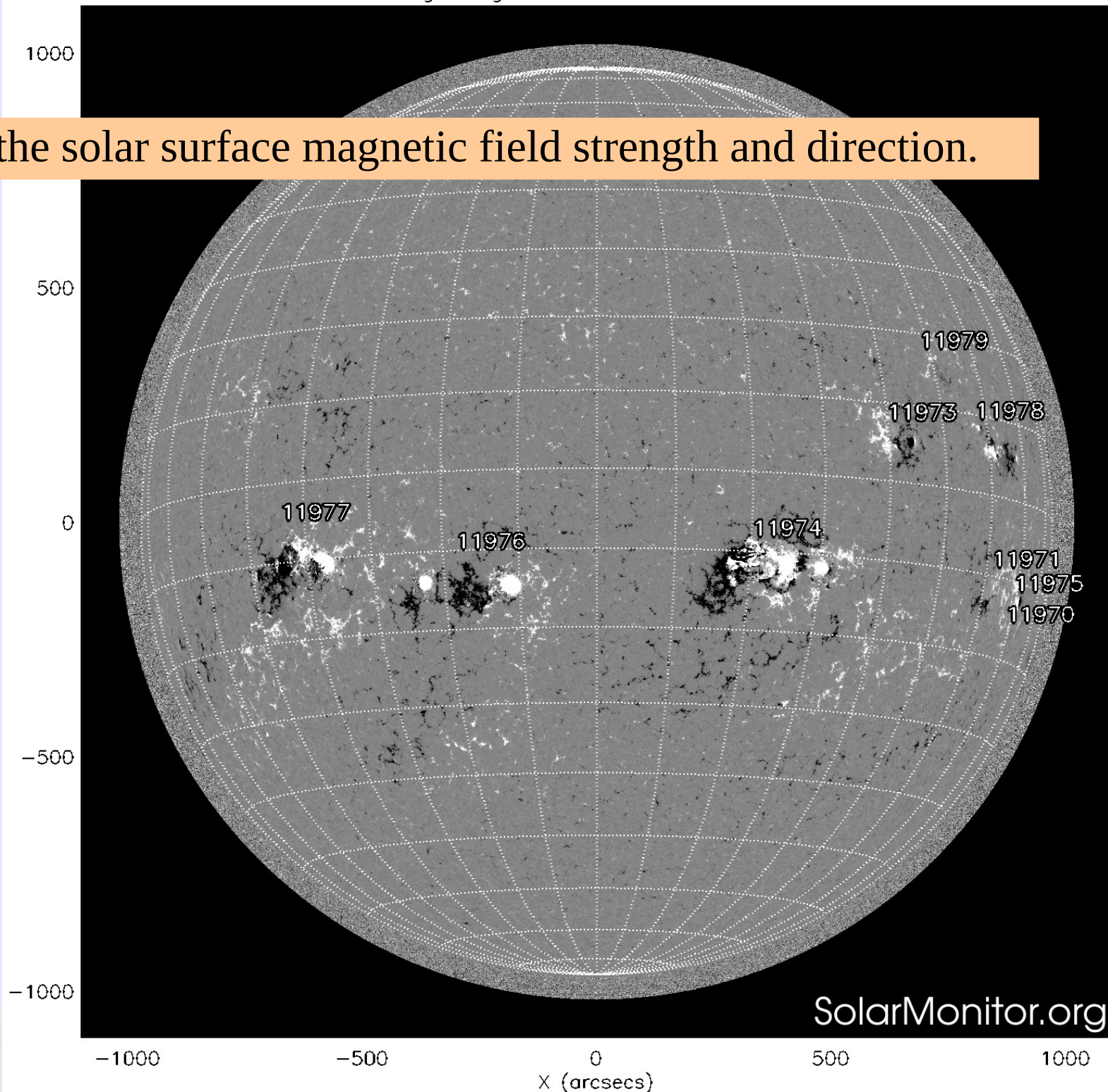
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Why useful?

What is it?

Measurements of the solar surface magnetic field strength and direction.



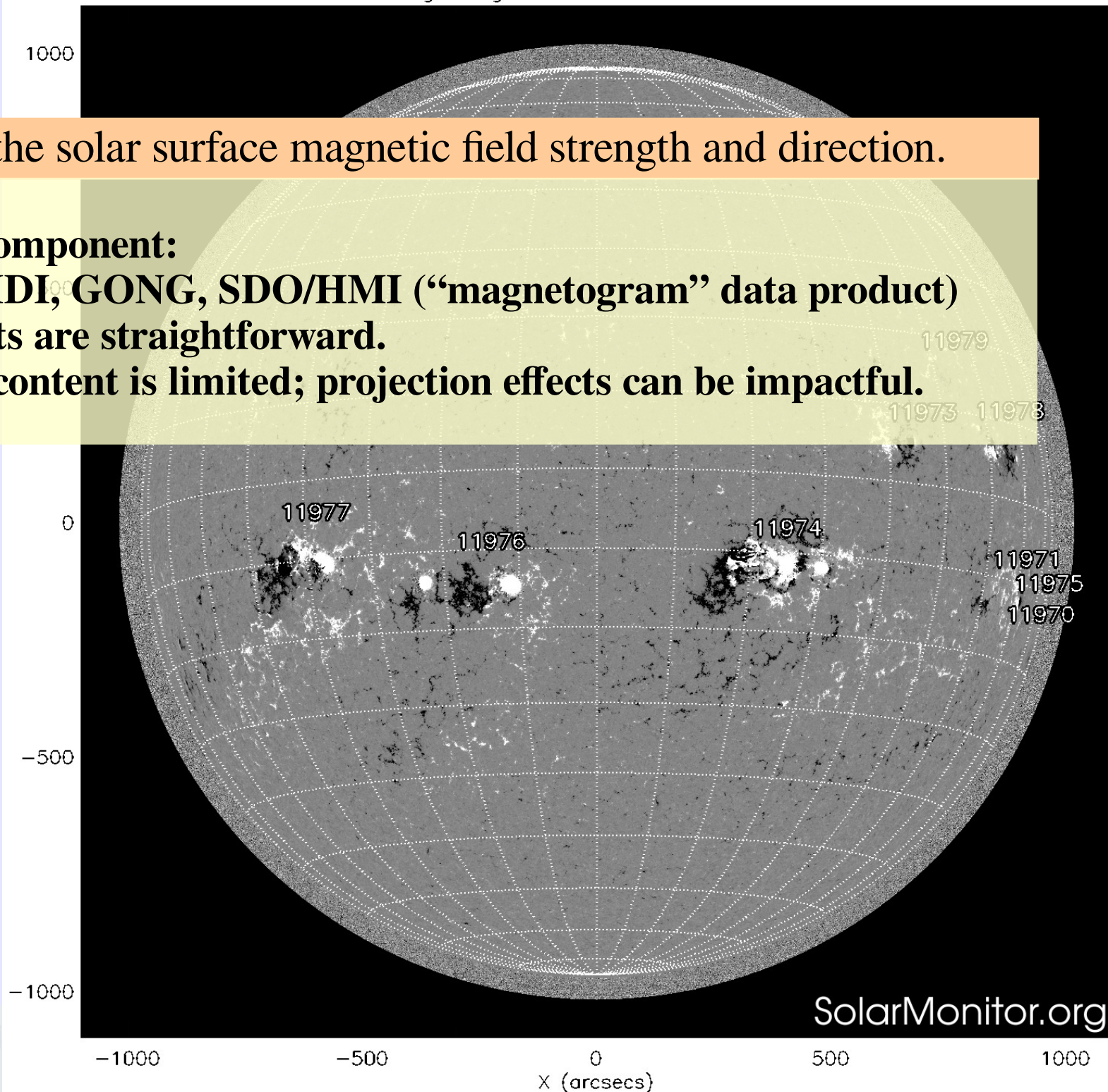
Why useful?

What is it?

Measurements of the solar surface magnetic field strength and direction.

Two flavors:

- **Line-of-sight component:**
 - *E.g.* SoHO/MDI, GONG, SDO/HMI (“magnetogram” data product)
 - Measurements are straightforward.
 - Information content is limited; projection effects can be impactful.



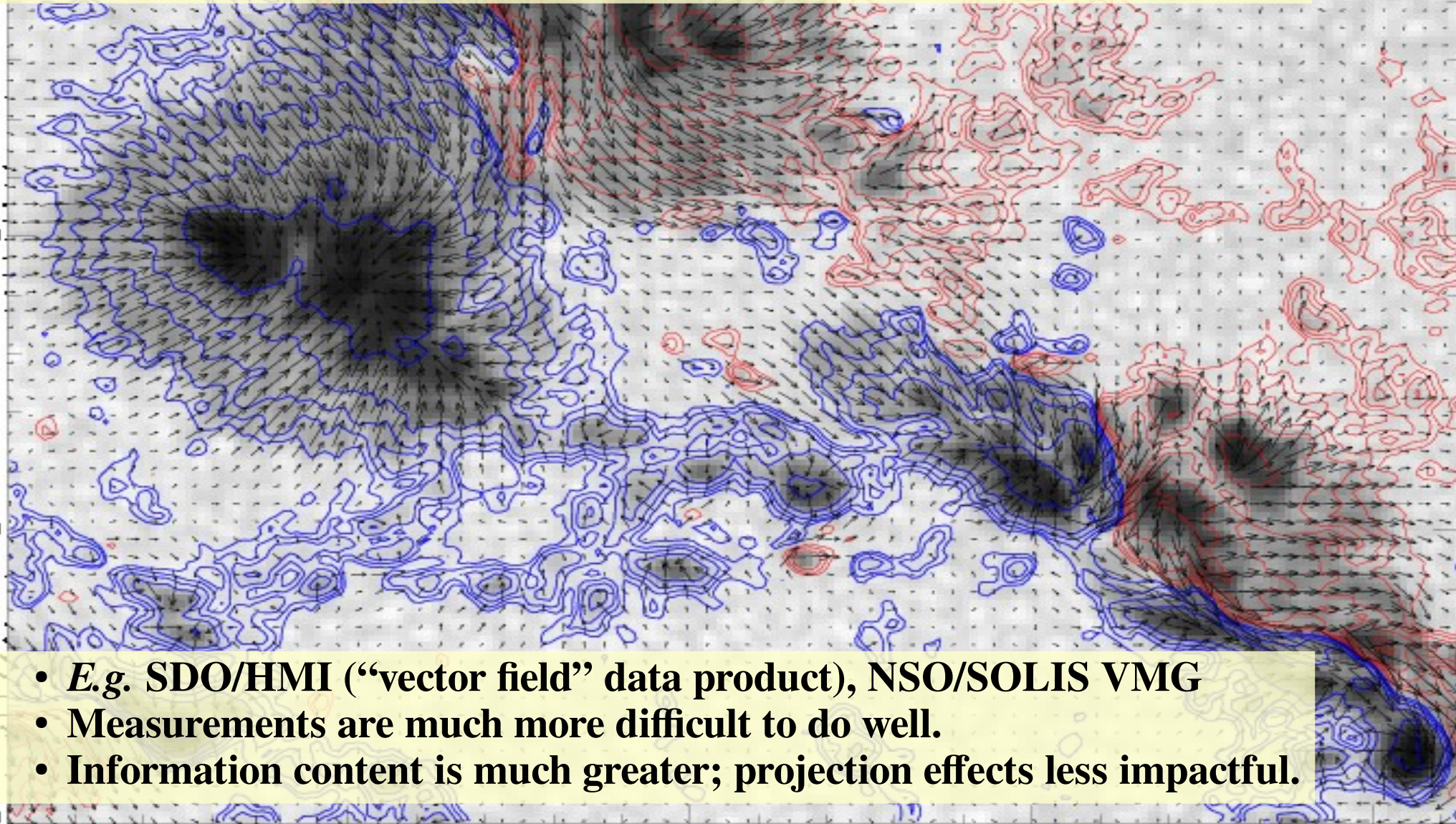
Why useful?

What is it?

Measurements of the solar surface magnetic field strength and direction.

Two flavors:

- Vector field data:



- *E.g.* SDO/HMI (“vector field” data product), NSO/SOLIS VMG
- Measurements are much more difficult to do well.
- Information content is much greater; projection effects less impactful.

Presently-operating full-disk sources of solar magnetic field data:

SDO/HMI:

- line-of-sight and vector
- photosphere
- < 1min (los); 12 min (vector) cadence
- 1" resolution & sampling
- 24/7 observing
- space-based NASA research mission.

NSO/SOLIS:

- line-of-sight photosphere & chromosphere;
vector photosphere
- 1" sampling
- few/day
- one ground-based site.

NSO/GONG:

- line-of-sight
- 2" resolution
- 10min cadence
- 24/7 observing via 6
ground-based sites

Huairou:

- line of sight and vector
- 2" sampling; 5" resolution
- one ground-based site
- present status??

Wilcox Solar Observatory

- line-of-sight
- 1—few / day
- 90" sampling
- one ground-based site

Others?

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Present Status and Utility of Operational Solar Magnetic Field Observations in the context of NOAA/GOES-NEXT

Dr. KD Leka
NWRA

- Why useful?
- **What's available now? Nothing*.**
- What would be viable/useful operationally?

Nothing* is presently constructed, funded, and *operated in a truly operational mode*. Presently, two sources of data are suitable for routine NOAA/SWPC use (NSO/GONG and SDO/HMI), but both are part of scientific experiments and funded/operated as such.

StrawMan requirements for GOES-NEXT Operational Magnetograph

Minimum:

- Line-of-sight
- Full-disk
- 60 min cadence
- 2" resolution and sampling.
- single photospheric spectral line
- temporally stable (or at least predictably variable)
- 5G noise

Better, but harder:

- 10-15 in cadence
- Vector
- 1" resolution and sampling
- additional chromospheric line

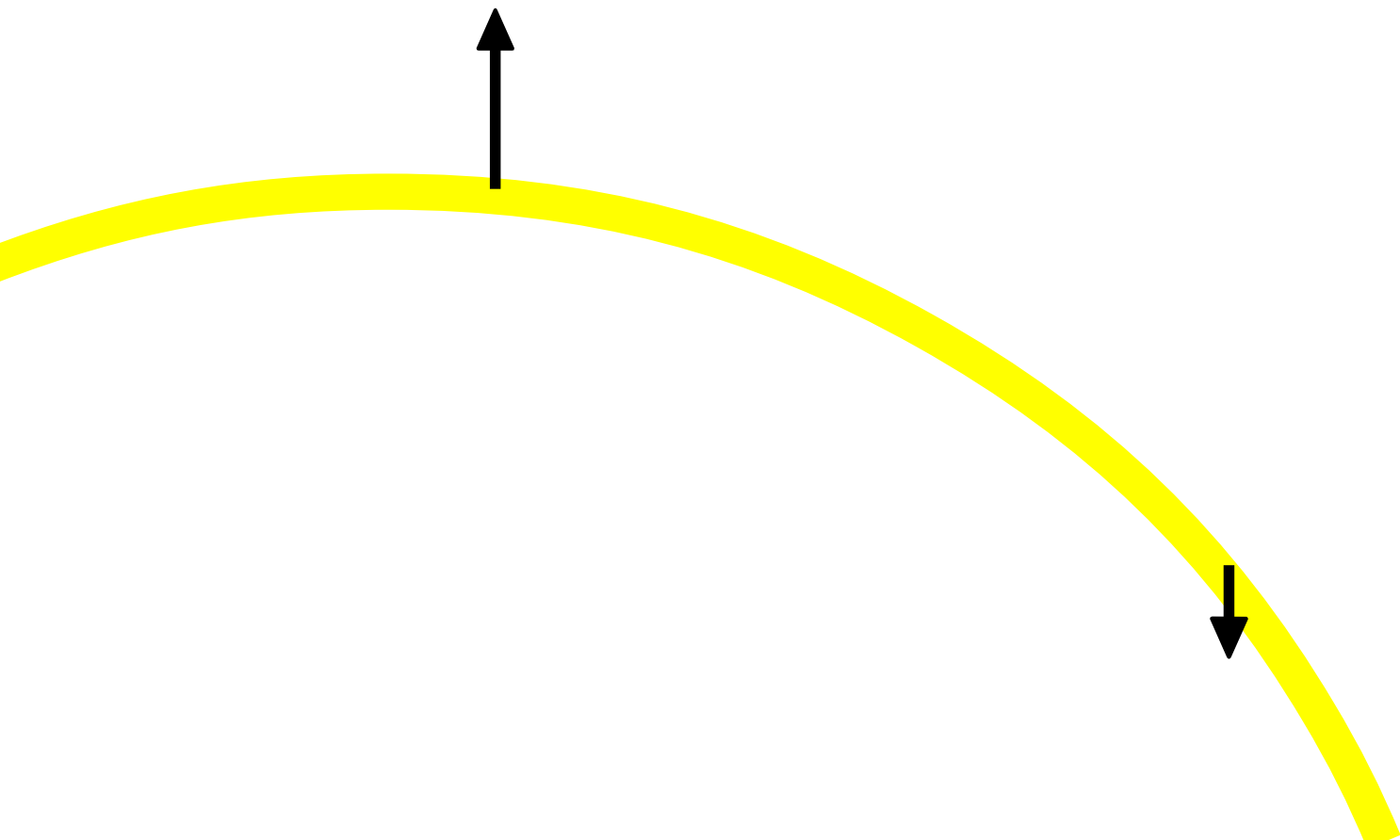
Consider:

- Matching/duplicating/funding existing facility
 - Longer baseline of data → better statistics for forecasting.

Line-of-sight
Magnetograph:





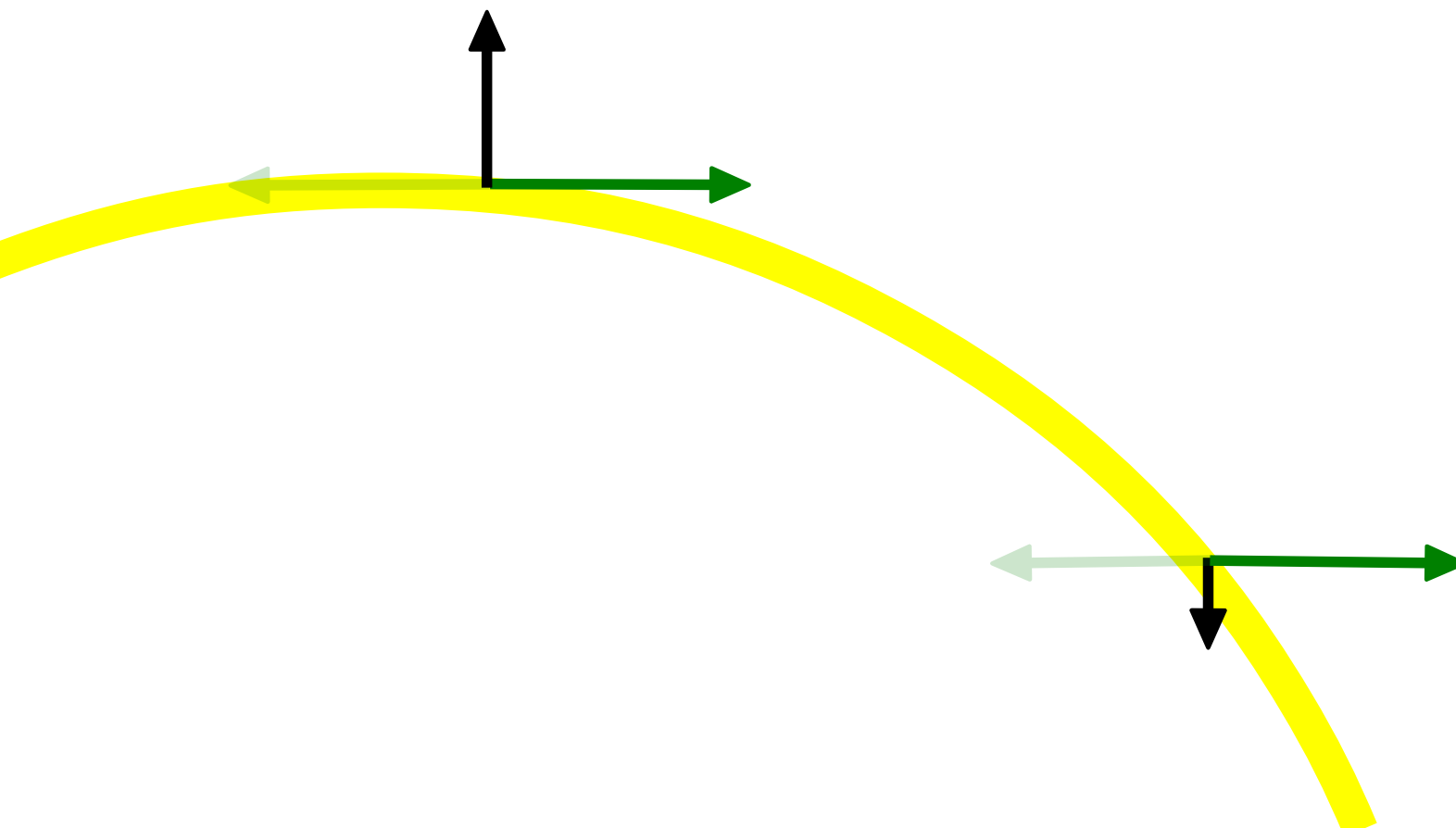
B line-of-sight









Vector
Magnetograph:

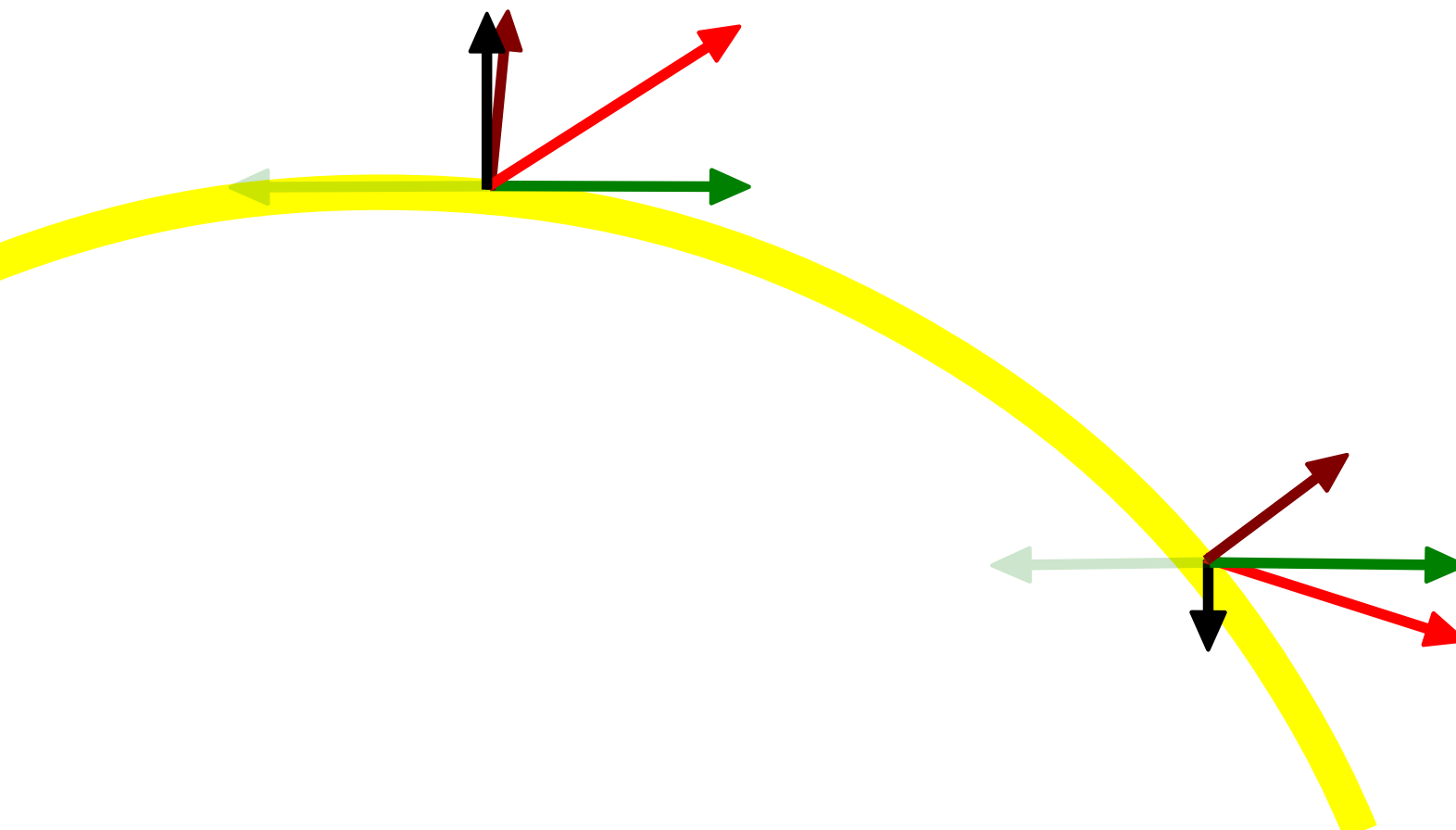
 *B line-of-sight*
 *B transverse*

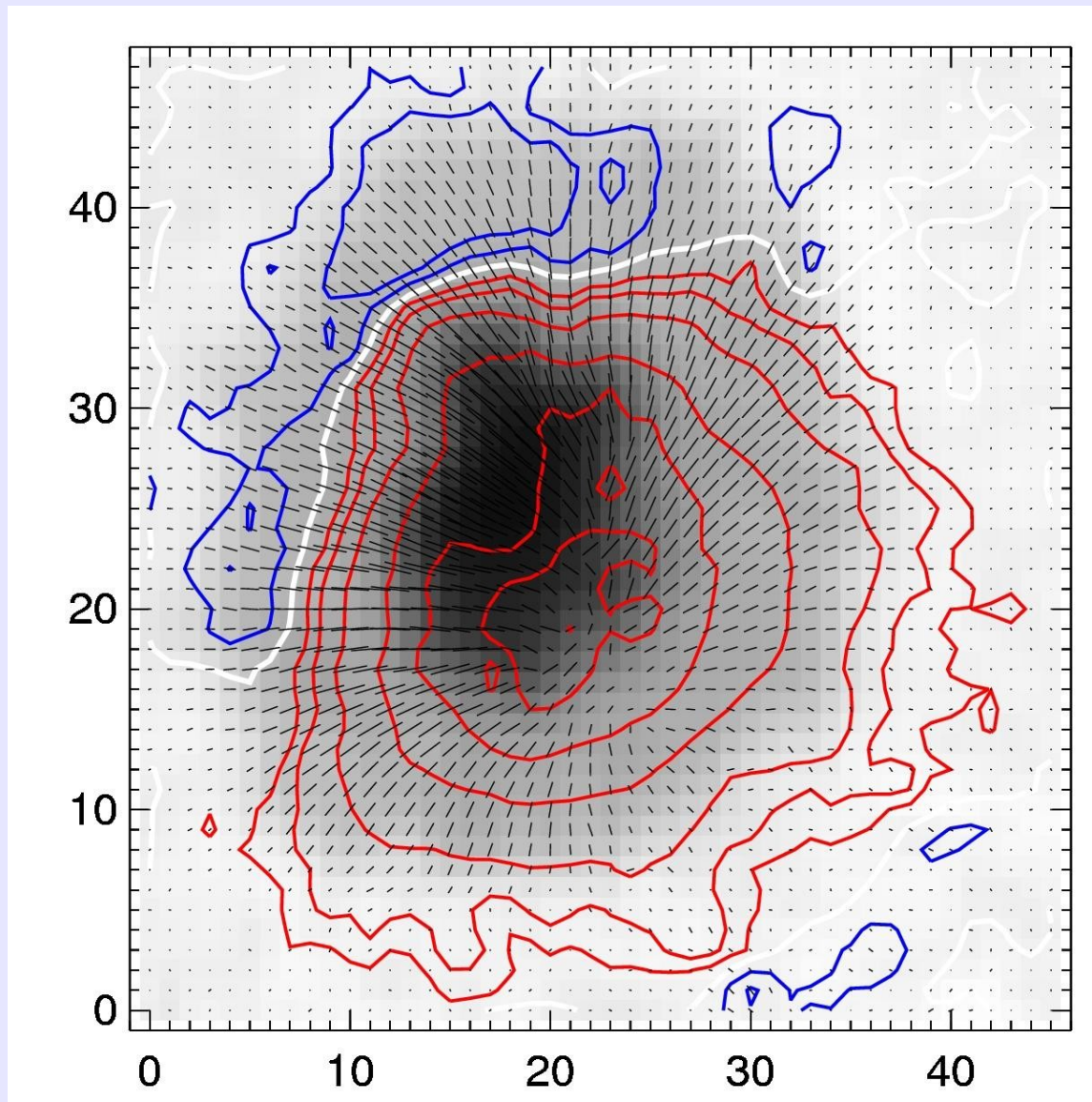


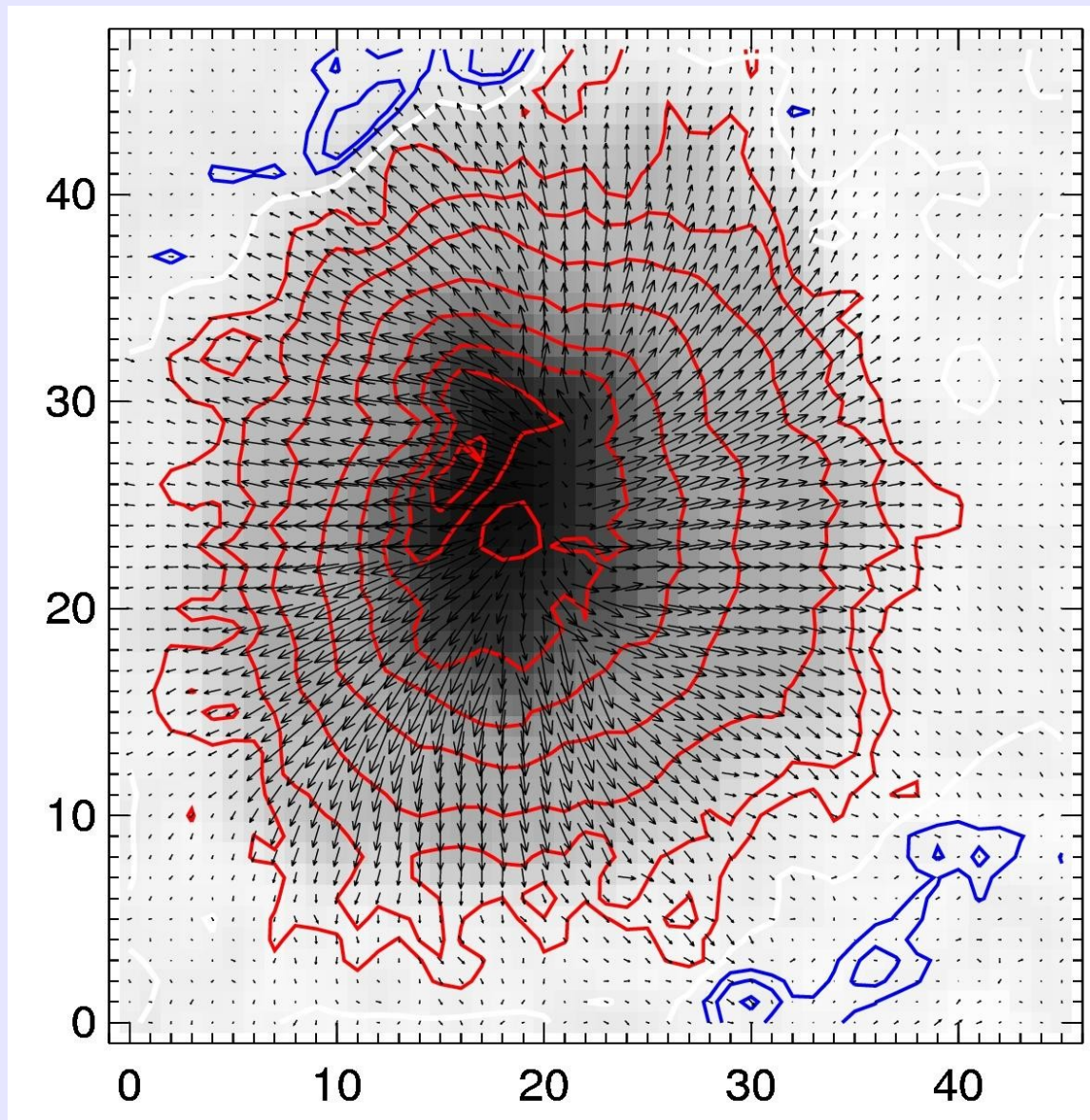
Vector
Magnetograph:



-  ***B line-of-sight***
-  ***B transverse***
-  ***B radial***
-  ***B vector***







Some Notes on Helioseismology for Far-Side Imaging

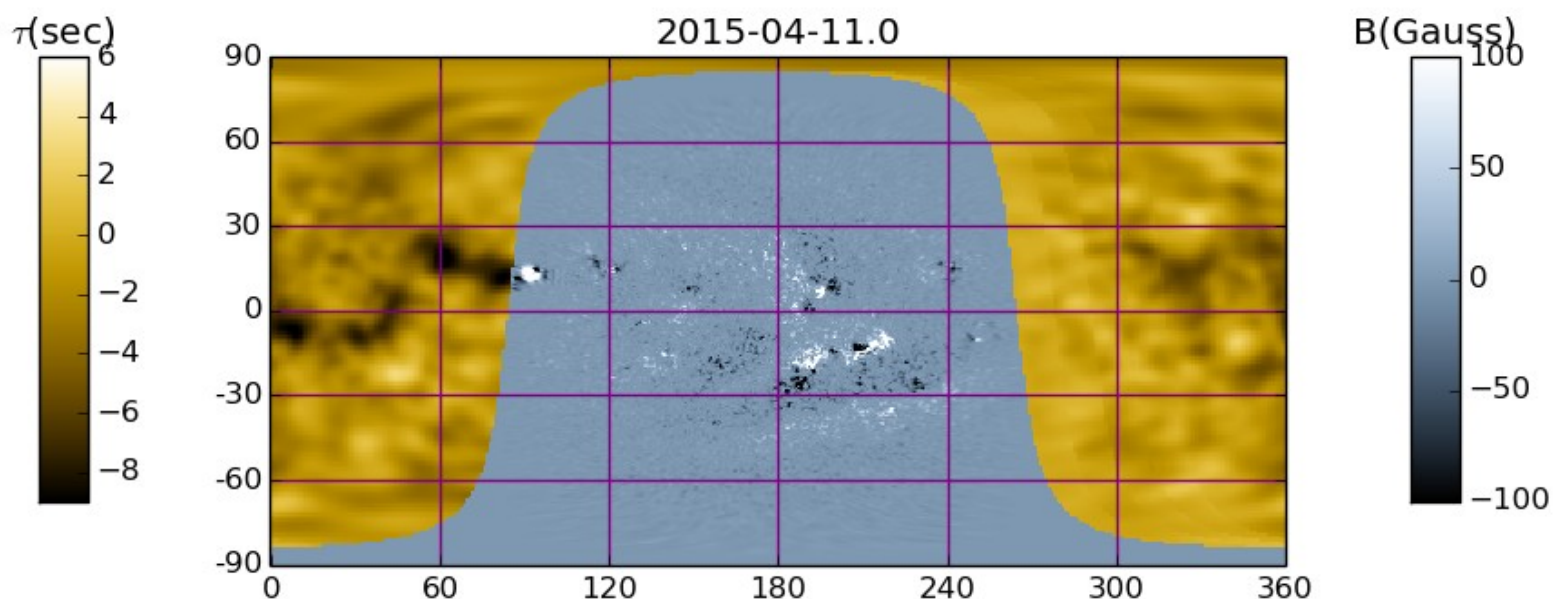
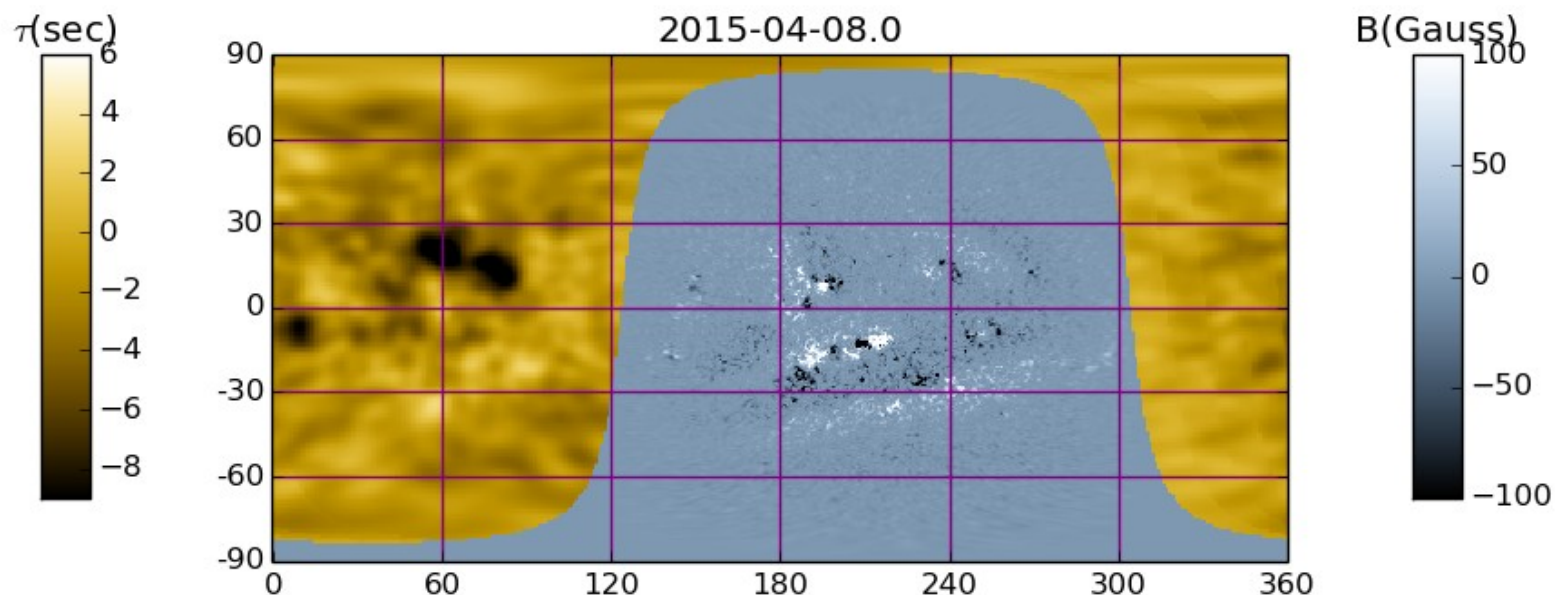
Composite maps of the full solar disk:

B/W: B_{los} , visible disk

Amber: Far-side seismic signature; darker is stronger/larger signal.

Top: a week ago. Large signal at N20 L70.

Bottom: two days ago. NOAA AR 12321 just starting to be visible at East limb.



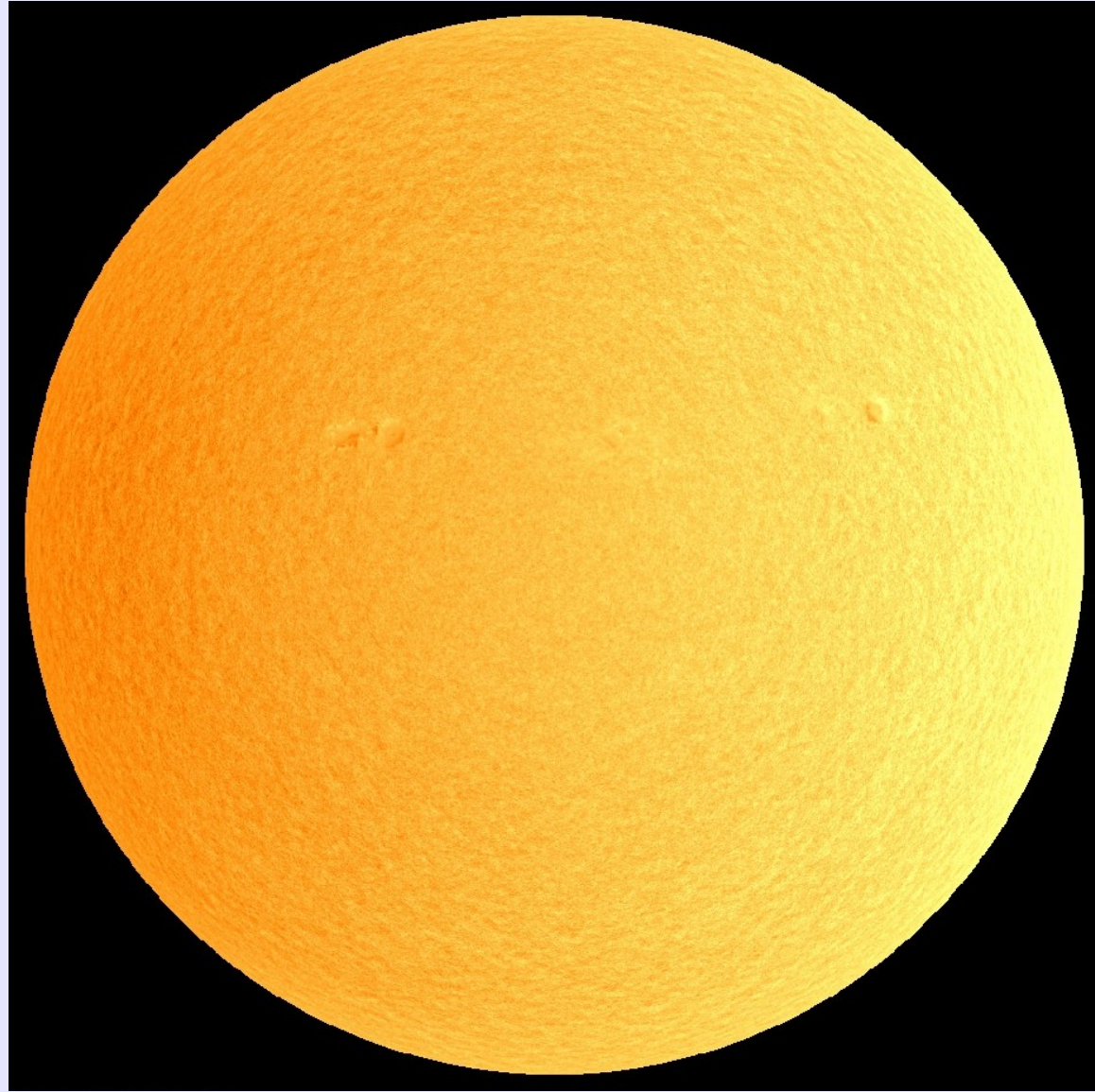
Courtesy: C Lindsey.

Why useful?

- Without STEREO, the only way to identify possible active regions on the far-side of the Sun.
 - Incoming solar activity.
 - Early warning for irradiance variations.
 - Global solar modeling (research).

Minimum Straw-man Requirements:

- Full-disk Doppler images in appropriate spectral line
- 2" spatial resolution (5cm aperture)
- 1 min cadence
- 24/7 data
- Temporally stable to 1 m/s over 20 min.



Doppler image from HMI

